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Know Your Phosphates!

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Know Your Phosphates!

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With Shortage of Superphosphate, Other Phosphate Fertilizers May Be Considered

IF WE ARE to keep up crop yields and quality, many of our soils must have phosphate fertilizer. If we can't get enough superphosphate because of the war, then what about the other phosphate fertilizers? Can they "pinch hit" for superphosphate?

We have done a lot of comparing results of superphosphate with rock phosphate here at the Iowa Station, and Station workers in cooperation with farmers have made many tests over Iowa on several different soil types. From these many years of testing, here are our conclusions and recommendations:

Results, Recommendations

1. Superphosphate generally gives higher increases in crop yields than rock phosphate. On certain soils, however, especially with legume crops, rock phosphate has given good results.

2. Only slight response is obtained with rock phosphate the first year, while superphosphate gives immediate returns.

3. Rock phosphate is more effective on acid than on limed or neutral soils, but it cannot take the place of lime.

4. Rock phosphate is cheaper per unit of total phosphorus than superphosphate but much larger amounts are required because of its low availability.

5. The best place for rock phosphate is with alfalfa and clover seedings, particularly sweet clover. The rate recommended is 500 to 800 pounds per acre.

6. Twenty percent superphosphate (0-20-0) should be used at from 150 to 200 pounds per acre for small grain and biennial legume seedings such as red clover and sweet clover. When alfalfa is seeded we recommend from 250 to 300 pounds per acre.

7. For corn we recommend about 100 pounds per acre of 20 percent superphosphate, or of a mixed fertilizer containing superphosphate, applied with a corn planter attachment at planting time. When broadcasting superphosphate for corn, about twice as much is necessary.

8. The supply of superphosphate during wartime will not meet the demand, and rock phosphate may well be used, especially for legume seedings where the soil is not alkaline or the acidity has not been fully corrected by liming.

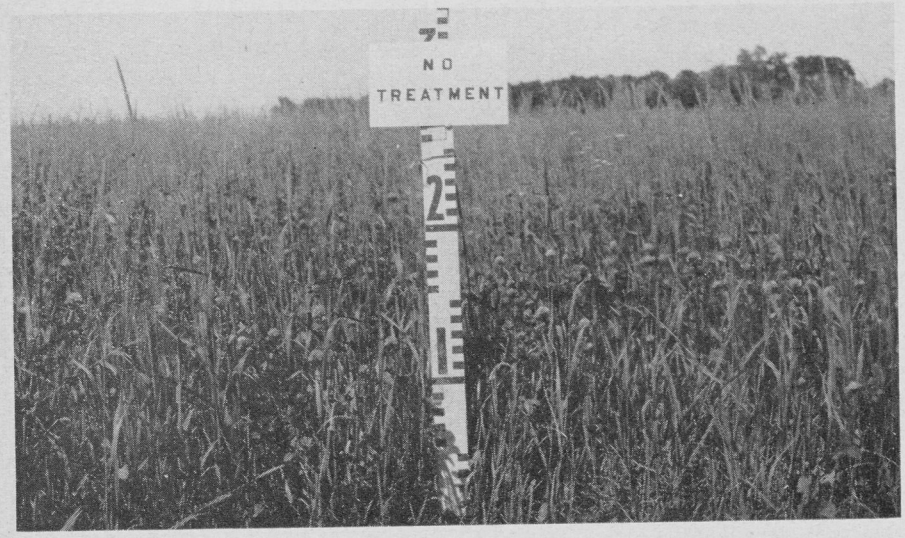
Lack of available phosphorus slows down plant growth, delays maturity and lowers the yield and quality of crops. Phosphorus is one element that is rapidly removed from the soil either in livestock or grain farming. Animals use the phosphorus in the feed they eat to build their bones—their bodies. We cannot avoid eventually having to replace this phosphorus which we are continually removing with any type of farming.

Only a small part of the phosphorus in our soils is available for plant use in any one year. So the availability of phosphate fertilizer applied is of importance if we are looking for quick returns. Phosphorus must be soluble to enable plants to use it. If one understands the characteristics of the various phosphate fertilizers, he is not so likely to be "taken in" by sales talk.

Phosphate Fertilizers

Rock phosphate is a finely ground phosphate-bearing rock, containing from 30 to 33 percent **total** phosphoric acid. Only a small amount of the phosphorus in it is readily available to crops—the

Here is how alfalfa responds to phosphate fertilizer. This is on the farm of Dave Hunter, Hamilton County. That which was limed only (left) had made a growth of approximately 1 foot when an adjoining area (right) which had received 100 pounds of triple-superphosphate (0-45-0) in addition to lime at the time of seeding was about 2 feet tall. The field was seeded in 1939, the photos made in 1940.



Rock phosphate brings about as good results as superphosphate on some soils as shown in the top and bottom photos (above) of timothy and red clover on the farm of H. E. Hazen, Denmark, Iowa (Lee County). The center photo shows the plot that did not receive lime, manure or phosphate. Corn yields on rock and superphosphate plots increased about 8-9 bu.

amount varying with different soils and crops. Legume crops such as red clover, alfalfa and sweet clover have a greater ability to use the phosphate in rock phosphate than the grain crops. Rock phosphate is less available in well-limed, neutral or alkaline soils than in acid soils, and it ordinarily should not be used on neutral or alkaline soils.

Rock phosphate has a place in a long-time soil-building program on some soils, but because of its slow availability, do not expect quick returns from it. Rock phosphate has no appreciable effect in correcting soil acidity, and there are no experiments indicating that the small amounts of other minerals in rock phosphate are of any direct benefit to crops and soils.

Superphosphate, a commercial product obtained by mixing rock phosphate with sulfuric acid, contains phosphorus in a form quickly available to plants. It is the most commonly used phosphate fertilizer. Superphosphate is usually sold under the label of 0-18-0 or 0-20-0, the middle figure designating the total amount of **available** phosphoric acid it contains. Higher analysis superphosphates are available in limited amounts.

Colloidal phosphate is a finely divided, relatively low grade type of rock phosphate or phosphate clay. It usually contains from 18 to 23 percent **total** phosphoric acid, with only a small amount readily available to plants. Experiments in some states have shown that colloidal phosphate has about the same fertilizing value as rock phosphate when it is applied on a phosphorus-equivalent basis.

Since colloidal phosphate contains only about two-thirds as much total phosphoric acid as rock phosphate, it has less value, ton for ton, and should be applied at a correspondingly higher rate than rock phosphate. If you consider buying colloidal phosphate, be sure to consider the comparative prices per unit of phosphoric acid with what it would cost you in rock phosphate.

Long-Time Experiments

Rock phosphate and superphosphate have been compared in

many experiments in Iowa. In early tests no attempt was made to apply the fertilizers on a phosphate-equivalent basis or equal money value basis. As a result, larger amounts of rock phosphate were used than we now recommend.

Table 1 is a summary of 20 years of experimental work with rock phosphate and superphosphate on 16 fields showing a definite response to phosphate and representing seven of the principal soil types of Iowa.

The soil types represented in this comparison were Carrington loam, Carrington silt loam, Clarion loam, Marshall silt loam, Grundy silt loam, Clinton silt loam and Waukesha silt loam.

In all but one comparison the average increase from superphosphate has been larger than that from rock phosphate, when used either with or without manure. The yield increase from both fertilizers was greater in all cases on manured than unmanured soils. The nitrogen added in the manure undoubtedly accounts for this.

Short-Time Experiments

In more recent experiments we have compared rock phosphate at two or three different rates with superphosphate at one rate. The standard rate for superphosphate has been 200 pounds per acre of 0-20-0 in a 3-year rotation of corn, oats and clover. Rock phosphate has been used on some fields on a phosphorus-equivalent basis, or 125 pounds per acre, as well as at 375 pounds per acre, representing about three times the phosphorus equivalent of superphosphate and about equal money value. Rock phosphate at 1,000 pounds per acre has been used on some fields as compared to 375 pounds.

In table 2 a summary of the relative response to rock phosphate and superphosphate is shown. The data represent results obtained on nine different soil types. Seven of the fields were limed, one was unlimed and one was nearly neutral in reaction.

In all but one case superphosphate increased the crop yield more than rock phosphate. In

Top: Manure, lime and superphosphate (120 pounds of 0-20-0 at time of seeding) boosted the oat yield 30 bushels an acre and nearly doubled the hay (alfalfa-red clover-timothy) yield over the check plot (center) which received no treatment. Bottom: Manure and lime alone lifted the oat yield 10 bushels and increased the hay yield about ½ ton per acre.

TABLE 1. RESPONSE OF DIFFERENT CROPS TO ROCK PHOSPHATE AND SUPERPHOSPHATE, WITH AND WITHOUT MANURE ON LIMED SOILS, IOWA AGRICULTURAL EXPERIMENT STATION—20 YEARS RESULTS.*

Crop		Average increased yields, bu. or lbs. per acre			
		In addition to manure and lime		Lime, but not manure	
		Rock phosphate	Super-phosphate	Rock phosphate	Super-phosphate
Corn	64 crops	4.7 bu.	5.7 bu.	2.1 bu.	2.1 bu.
Wheat	25 crops	4.9 bu.	5.9 bu.	4.2 bu.	5.7 bu.
Oats	68 crops	4.7 bu.	8.3 bu.	4.6 bu.	6.3 bu.
Red clover	39 crops	735 lbs.	920 lbs.	590 lbs.	760 lbs.
Alfalfa	43 crops	485 lbs.	770 lbs.	470 lbs.	600 lbs.

*The average annual fertilizer application and approximate cost of fertilizer per acre were: Rock phosphate 250 pounds costing $2.25 ($18 per ton) and superphosphate, 90 pounds of 0-20-0 costing $1.15 ($26 per ton).

Rock phosphate was applied once in a 4-year rotation (1000 lbs.) at the time of turning under the sod for the first corn crop, while superphosphate was applied to all grain crops. Manure was applied at the rate of 8 tons per acre once in a 4-year period. Limestone was applied according to soil tests.

TABLE 2. RELATIVE RESPONSE TO ROCK PHOSPHATE AND SUPERPHOSPHATE ON FIELDS SHOWING A DEFINITE RESPONSE TO PHOSPHATE, IOWA AGRICULTURAL EXPERIMENT STATION, 1937 TO 1944.

Crop		Average increased yields, bushels or pounds per acre			
		Super-phosphate 200 lbs. 0-20-0	Rock phosphate 125 lbs. per A.	Rock phosphate 375 lbs. per A.	Rock phosphate 1000 lbs. per A.
Oats	3 fields	5.1 bu.	0.7 bu.	1.5 bu.	no plots
Oats	4 fields	6.5 bu.	no plots	4.2 bu.	4.2 bu.
Red clover	2 fields	400 lbs.	200 lbs.	240 lbs.	no plots
*Red clover	2 fields	740 lbs.	no plots	700 lbs.	940 lbs.
Alfalfa (4 cuttings)	2 fields	540 lbs.	220 lbs.	320 lbs.	no plots

*One field was on a medium acid Carrington silt loam.

Approximate cost of fertilizers per rotation: Superphosphate, 200 lbs. 0-20-0—$3; rock phosphate, 125 lbs.—$1; rock phosphate, 375 lbs.—$3; rock phosphate, 1000 lbs.—$8.

TABLE 3. INCREASED YIELDS FROM SUPERPHOSPHATE AND ROCK PHOSPHATE ON A MEDIUM ACID SOIL, COMPARED WITH THE INCREASES ON A NEARLY NEUTRAL SOIL.

Crop	Medium Acid Soil Carrington Silt Loam Cedar Rapids, 1942-1944			Nearly Neutral Soil Webster Silty Clay Loam Ames, 1943-1944		
	Super-phosphate 200 lbs. 0-20-0	Rock phosphate 375 lbs.	Rock phosphate 1,000 lbs.	Super-phosphate 200 lbs. 0-20-0	Rock phosphate 375 lbs.	Rock phosphate 1,000 lbs.
Oats	7.5 bu.	3.3 bu.	1.3 bu.	5.0 bu.	2.9 bu.	4.8 bu.
Red clover	380 lbs.	780 lbs.	1060 lbs.	1100 lbs.	620 lbs.	800 lbs.

general, legume crops have shown a greater response to rock phosphate than the grain crops. Superphosphate has been more profitable than rock phosphate both when used in phosphorus-equivalent amounts and in equivalent money value amounts.

Acid, Neutral Soils

It is generally recognized that rock phosphate has a greater effect on acid soils than superphosphate. A comparison of the fertilizers on two different soils is shown in table 3.

In general the response to rock phosphate was greater on the Carington silt loam, an acid soil, than on the Webster silty clay loam, which was near neutral in reaction. This does not mean that rock phosphate can take the place of lime on acid soils, but means that rock phosphate is a more effective carrier of phosphorus on acid soils than on limed or neutral soils. However, for the sucessful growing of crops like alfalfa and sweet clover, lime is essential.

A Final Word

Both superphosphate and rock phosphate have a place in the Iowa fertilizer program. Until the war ends there is not likely to be enough superphosphate to meet all demands. Rock phosphate can well be used for legume seedings on many acid soils where the acidity has not been fully corrected with lime. It should generally not be used on alkaline or neutral soils. Superphosphate should be used in all cases where immediate returns are expected, and where soils are neutral or alkaline in reaction.

EARLYANA PROMISING SOYBEAN

One of the promising new soybean varieties for northern Iowa is the Earlyana. In seven tests in northern Iowa from 1941 to 1943, inclusive, it has outyielded Richland an average of about 2 bushels an acre and has matured an average of 3 days earlier.

But one of the strong points of Richland—the ability to stand up—is not so good in the Earlyana. The Earlyana seed will not be generally available in Iowa for a year or two.

This variety was developed at the Indiana Station. It grows 5 to 6 inches taller than Richland and is adapted to the less fertile soils of northern Iowa.

It is not unusual in good seasons for the better strains of bromegrass to produce 400 to 500 pounds of seed to the acre.